

### Remarks

Claims 1 - 4 are amended to correct an informality (correcting for a lack of proper antecedent basis). The specification and drawings are amended to correct errors of a typographical or editorial nature. No new matter is introduced by any of the inventions, and entry thereof is requested

Claims 1 - 22 are in the Application, of which claims 12 - 20 have been withdrawn as directed to a nonelected invention. Accordingly, claims 1 - 11, 21 and 22 are now under consideration in the application.

Reconsideration of the application, as amended, is requested.

The points raised in the Office action will now be addressed.

### Drawings Objections

The drawings were objected to under 37 CFR 1.84(p)(5), the Examiner asserting that “they include the following reference characters not mentioned in the description: 11, 43, 47, 50, 52, 86, 90, 92, 142, 305, 306, 313, 818”, and noting further that “Fig. 6B has two lines that are not represented by references numerals.” The Examiner required correction of the drawings, or amendment of the specification.

Application thanks the Examiner for attention to the details of the specification. The specification and drawings are amended herein to correct errors of a typographical or editorial nature, and to bring the drawings and specification into conformity, as detailed below. No new matter is introduced by any of the amendments, and entry thereof is requested.

Certain of the reference characters said not to be mentioned in the specification are in fact described in the specification as filed. Particularly:

An “adhesive **43**” is described at paragraph [0026], at line 26 on page 6;

An embodiment of a multi-package module is shown “generally at **50**” is described at paragraph [0097], at line 21 on page 19;

An “MPM **52**” is described at paragraph [00113] at line 24 on page 24;

“[V]ias **142**” are described at paragraph [0026] at line 18 on page 6;

An “underfill **313**” is described at paragraph [00136] at line 32 on page 31;

“[S]older balls **318**” are described at paragraph **[00140]**, at line 25 on page 32. Accordingly the objections as to these reference numerals (43, 50, 52, 142, 313, 318) should be withdrawn.

As to reference characters not mentioned in the specification, the specification and drawings are amended as follows:

- **11** -- is inserted following “BGA” in paragraph **[0018]**;
- **47** -- is inserted following “encapsulated” in paragraph **[0025]**;
- “**84**” is replaced with -- **86** -- in paragraph **[00177]**;
- **90, 92** -- is inserted following “embodiments of the invention” in paragraph **[00180]**;
- “**355**” is replaced with -- **305** --, “**356**” is replaced with -- **306** --, and “**354**” is replaced with -- **304** -- (paragraph **[00165]**) to make the text consistent with the reference numeration of FIG. **8C** and to avoid use of any reference numeral to identify more than one feature. It is noted that metal layer **355** is sandwiched between dielectric layers **354, 356** in bottom package substrate **342** (*see, e.g.*, paragraph **[00157]**, Figs. **8A, 8B, 8C**). Accordingly, Fig. **8B** is amended to make the reference numeration consistent with that of Fig. **8C**, by replacing the instances of reference numerals **354, 355, 356** that are directed to the lower planar part and the legs or sidewalls of the heat spreader, and the adhesive by which the heat spreader is affixed to the substrate, with, respectively, numerals **304, 305, 306**;

In Figs. **7A, 7B** and **7C**, the lead line from reference numeral **315** is moved, to indicate the “solder mask”, *see* paragraph **[00140]**. It is noted that reference numeral **313** indicates the underfill, *see* paragraph **[00136]**.

The objections as to these reference numerals (11, 47, 86, 90, 92, 305, 306, 313, 318) can now be withdrawn.

As to the objection to Fig. **6B**, Fig. **6B** is amended herein by insertion of missing reference numeral **406**, and **407** (2 instances), to be consistent with the description and with the reference numeration of Fig. **6A**, and this objection can now be withdrawn.

Rejections under 35 U.S.C. § 103(a)

The claims were rejected under 35 U.S.C. § 103(a) for obviousness over Akram *et al.* U.S. 6,590,281 (“Akram”) in view of Wu *et al.* U.S. 6,590,281 (“Wu”) and Belopolsky U.S. 6,791,845 (“Belopolsky”).

As to independent claims 1, 21 and 22 the Examiner asserted:

Akram teaches a multi-package module 100 comprising stacked lower 116, 128 and upper packages 140, 162, each said package including a die 128, 162 attached to a substrate 116, 140, wherein the upper package 140, 162 is inverted and wherein the upper and lower substrate 116, 140 are connected by wire bonding 148 (see col. 3 lines 43-60, col. 5 lines 55-67, and col. 6 lines 1-54; Fig. 1).

The Examiner acknowledged that Akram “fails to disclose a package with a stacked die package.” Wu is relied upon as disclosing “a package 2 with a stacked die package 20, 24, 25.” The Examiner states, “thus, Akram and Wu have substantially the same environment of a chip mounted on a substrate by solder bumps, wherein the chip is encapsulated”, and argues that it would have been obvious to substitute a stacked die package for the upper package of Akram, since the stacked die package would increase the chip capacity of the semiconductor package without altering the package profile as taught by Wu.” These rejections are traversed, for at least the following reasons.

Akram does not disclose that the upper and lower substrates are electrically interconnected by wire bonding. Akram states in Summary:

The substrates are preferably stacked atop one another by **electric connections which are ball or column-like structures**. Alternately, solder bumps or balls may be formed on the substrate. The electric connections achieve electric communication between the stacked substrates. ... The electric connections **must be of sufficient height to give clearance** for the components mounted on the substrates **and should be sufficiently strong enough to give support between the stacked substrates**.

Akram describes stacked multisubstrate devices in which multiple substrates are stacked atop one another by electric connections which are ball or column-like structures - a so-called column grid array configuration (Summary, Col.3, lines 49 - 52). The electric connections both provide support of the second substrate over the first and provide electrical connection between the substrates (Col. 3, lines 52 - 55). The electrical connection is made, according to Akram, between bond pads on the upward-facing side of the lower substrate, and a downward-facing side of the upper

substrate; they are preferably distributed evenly around the base and stacked substrates, but “the electric connections may be of any distribution so long as adequate mechanical support exists between the base substrate and the stacked substrate” (Col. 4, lines 32 – 44). Further:

The second electric connections **148** extend between each second stacked substrate **140** having a first surface bond pad **144** and its respective first stacked substrate second surface bond pad **124**. The bond pads of both the second stacked substrate **140** and first stacked substrate **116** are preferably located such that each respective bond pad pair aligns perpendicularly.

Such “electric connections” are not wire bonds; nor can wire bonds (as that term is understood in the art) be made by connection between such opposed and perpendicularly aligned pads. Accordingly, notwithstanding the mere mention at Col. 3, line 59 of “wire bonds” in a list of industry “techniques” for forming electric connections, Akram nowhere shows or suggests how wire bonds could be used to make the electric connections which would be “strong enough to give support between the stacked substrates” (Col. 3, lines 60 – 63). To the extent Akram may be pertinent, it teaches away from z-interconnection between stacked packages by wire bonding, by repeated description of the arrangement of pads (in perpendicular alignment on the upward-facing side of a lower substrate and the downward-facing side of an upper substrate) and by the repeated assertion that the electrical connections should provide support between the stacked substrates.

According to Applicant’s invention, by contrast, the package-to-package z-interconnect wire bonds are formed (in a conventional wire bonding process, either forward- or reverse-bonding) as wire bonds between pads on an upward-facing side of a second (“upper”) package substrate and pads on an upward-facing side of a first (“lower”) package substrate. (*See, e.g.*, Applicant’s specification, paragraph [00102].

Accordingly, Akram does not describe “stacked ... second and first substrates interconnected by wire bonding”, as in Applicant’s invention as claimed. Wu, relied upon as teaching a “stacked die package”, cannot supply what Akram lacks and, accordingly, no combination of Akram and Wu makes Applicant’s claimed invention. The rejection of claims 1, 21 and 22 for obviousness over Akram with Wu should be withdrawn.

As to claim 5, the Examiner asserts that “Wu discloses wherein adjacent stacked die in the stacked die package are separated by a spacer (i.e. adhesive layer) (see col. 4 lines 20-24; Figs. 4, 6 and 7).” As to claim 6, Wu is relied upon as teaching a heat spreader; as to claim 7, Akram is

relied upon as teaching an additional inverted package stacked over the second package.

(Applicant disagrees with the Examiner's interpretation of the adhesive layer as a "spacer". The adhesive layer of Wu is employed to affix a smaller second die to the active side of a larger first die, and neither does it serve as a spacer nor is a spacer necessary in view of the fact that the second die is smaller than the first. (*Cf.*, *e.g.*, Applicant's specification at paragraph [00181].)

As explained above with reference to claims 1, 21 and 22, no combination of Wu with Akram describes Applicant's claimed invention, and the rejections of claims 5, 6 and 7 for obviousness should be withdrawn.

As to claims 8 - 11, the Examiner asserts that "Akram teaches a package with a ball or column grid array package (see col. 3 lines 45-60) as additional inverted package stacked over the second package (see Fig. 4). The additional package is a flip chip package (see col. 1 lines 14-35)." Then the Examiner asserts that "[i]t is well known in the industry to substitute a land grid array for a ball grid or column grid array as evident by Belopolsky (see col. 1 lines 15-18)." This rejection is not well understood.

As explained above with reference to claims 1, 21 and 22, no combination of Wu with Akram describes Applicant's claimed invention, and the rejections of claims 8 - 11 for obviousness should be withdrawn.

#### Double Patenting

Claims 1 - 11, 21, and 22 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting: over claim 1 of copending Application No. 10/681,572; over claim 1 of copending Application No. 10/681,734; or over claim 1 of copending Application No. 10/681,584.

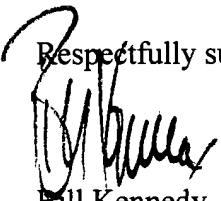
These provisional obviousness-type double patenting rejections will be addressed in a suitable manner once a conflicting claim has in fact been patented.

In view of the foregoing, all the claims now in the application, namely claims 1 - 11, 21 and 22, are believed to be in condition for allowance, and action to that effect is respectfully requested

This Response is being filed within the third month following the three months' shortened statutory period set by the Examiner for response to the Office action and, accordingly, it is accompanied by a Petition for three months' extension of time and a fee or fee authorization therefor. In the event the Examiner may determine that additional fee[s] may be required in connection with the filing of this paper, the Commissioner is authorized to charge any additional fee (or to credit any overpayment) to Deposit Account No. 50-0869 (CPAC 1029-7).

If the Examiner determines that a conference would facilitate prosecution of this application, the Examiner is invited to telephone Applicants' representative, undersigned, at the telephone number set out below.

Respectfully submitted,

  
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**Appendix**

Replacement sheet[s]

Annotated sheet[s] showing changes

### **Amendments to the Drawings**

The attached sheets of drawings include changes to FIGs. 6B, 7A, 7B, 7C and 8B. Sheet 5 / 20, which includes FIGs. 6A and 6B, replaces original sheet 5 / 20 including FIGs. 6A and 6B; sheet 6 / 20, which includes FIGs. 7A and 7B, replaces original sheet 6 / 20, including FIGs. 7A and 7B; sheet 7 / 20, which includes FIG. 7C, replaces original sheet 7 / 20, including FIG. 7C; sheet 8 / 20, which includes FIGs. 8A, 8B and 8C, replaces original sheet 8 / 20, which includes FIGs. 8A, 8B and 8C. In FIG. 6B previously omitted reference numerals **406** and **407** (2 instances) are added. In FIG. 7A, 7B and 7C, the lead line running from reference numeral **315** is repositioned. In FIG. 8B reference numerals **304**, **305** (2 instances) and **306** (two instances) replace erroneous instances of reference numerals **354**, **355** and **356**, respectively.

Attachment: Replacement sheet[s] 5 / 20, 6 / 20, 7 / 20, 8 / 20

Annotated sheet[s] showing changes



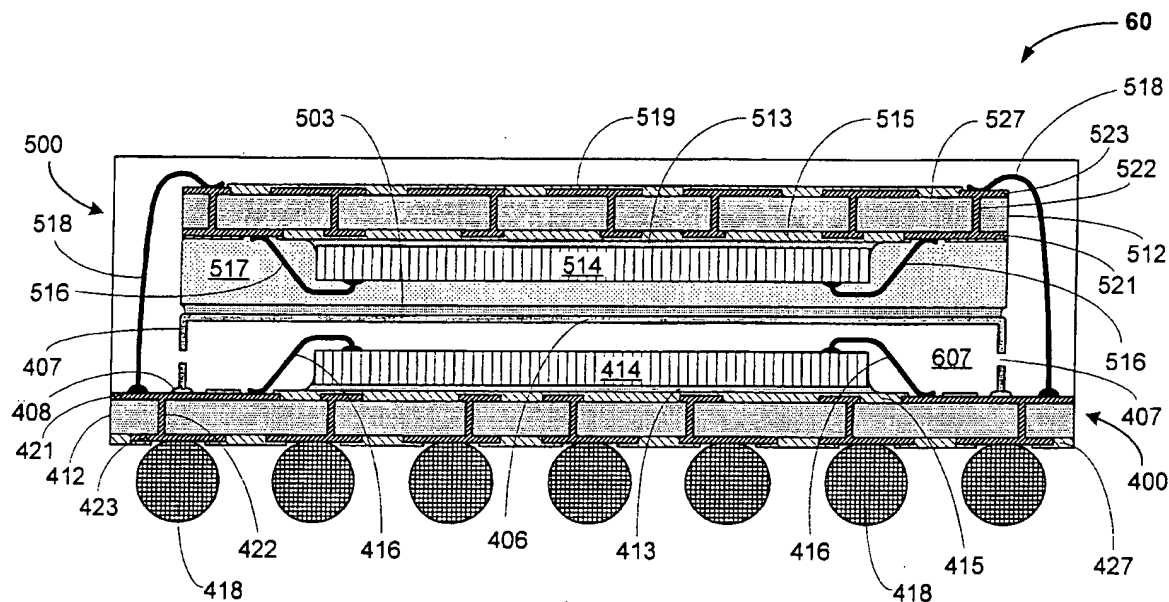
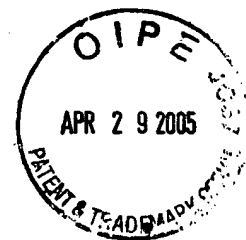


Fig. 6A

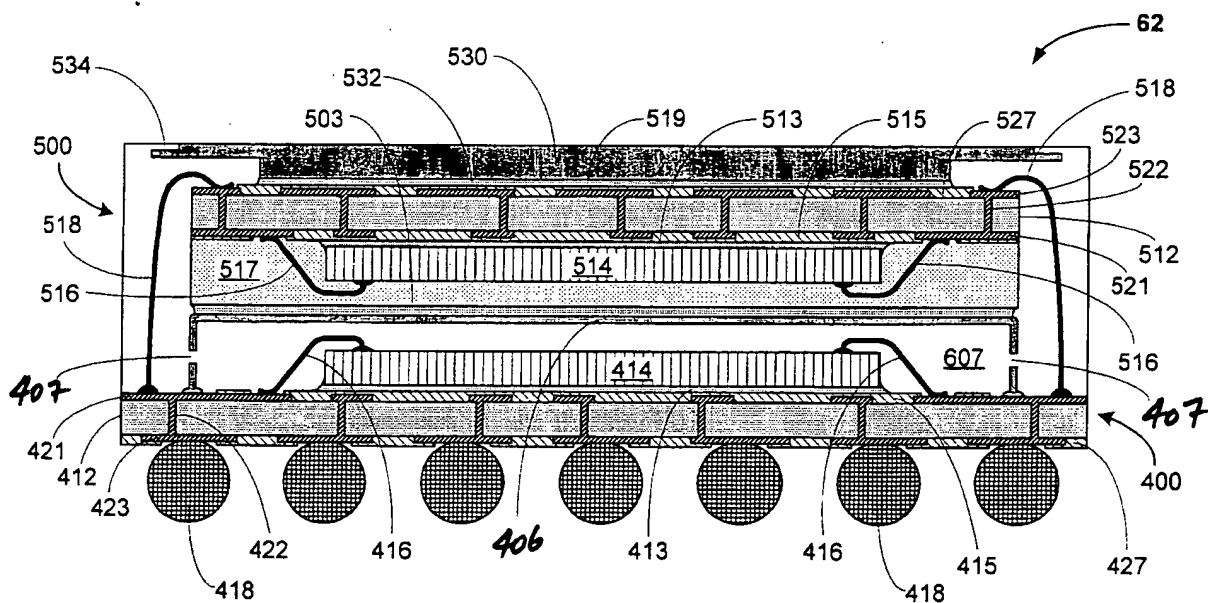


Fig. 6B

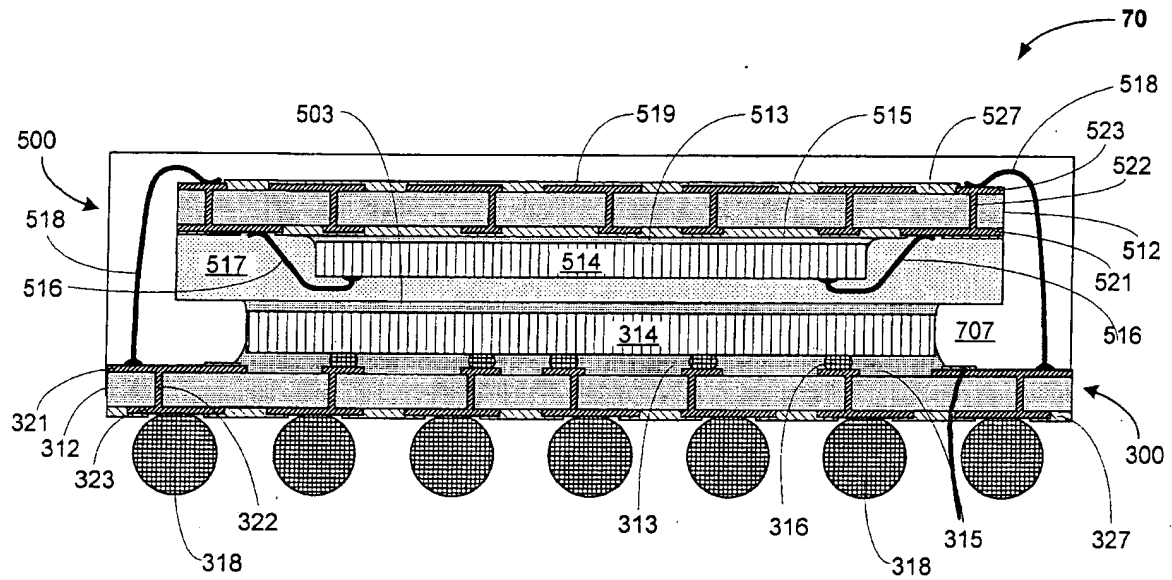


Fig. 7A

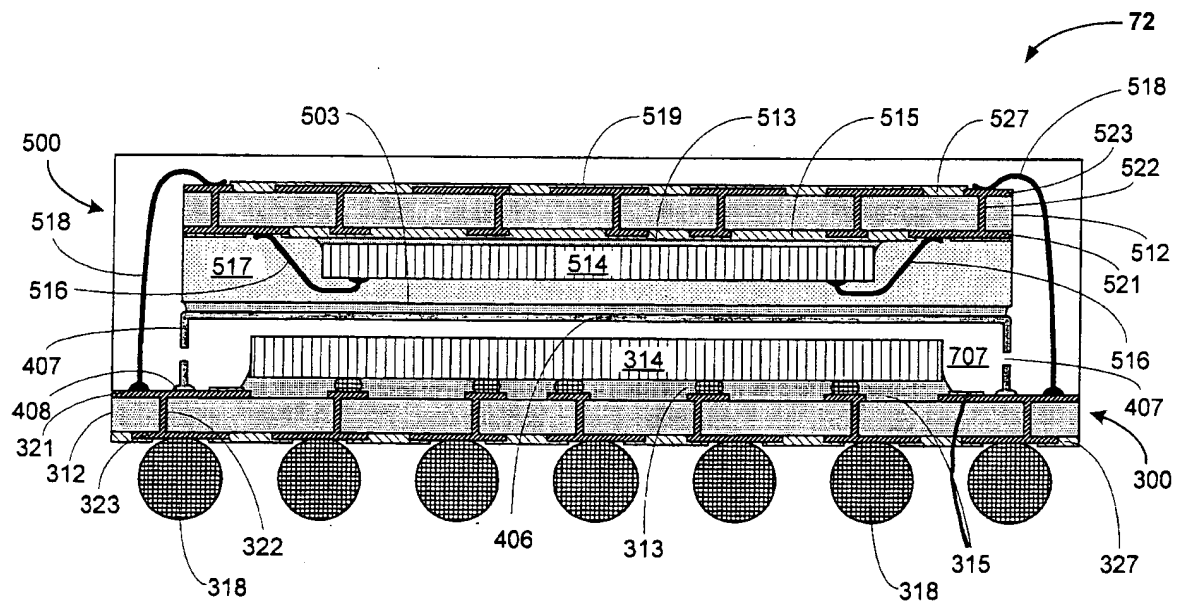


Fig. 7B

**Fig. 7C**

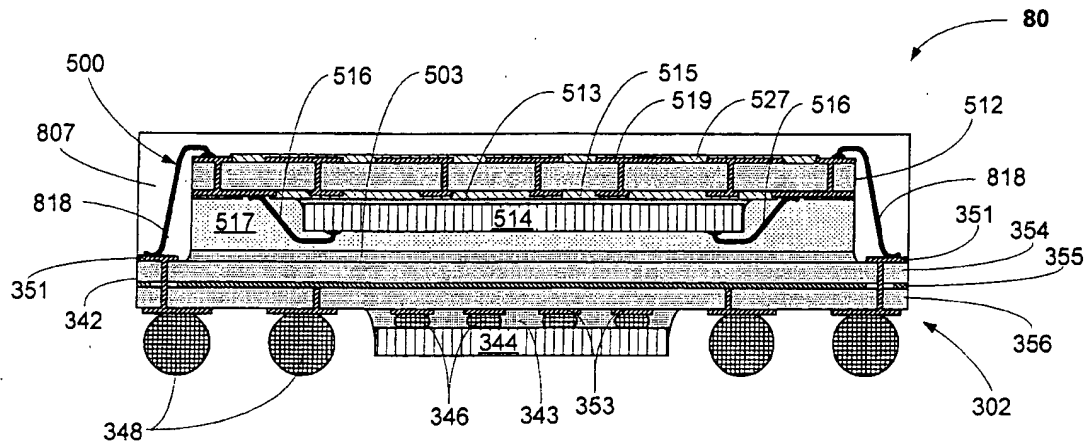


Fig. 8A

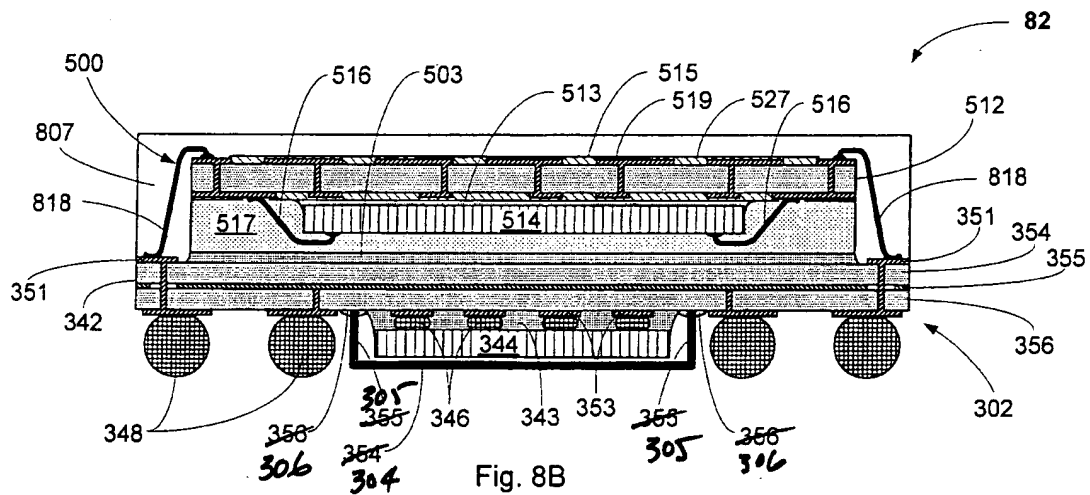


Fig. 8B

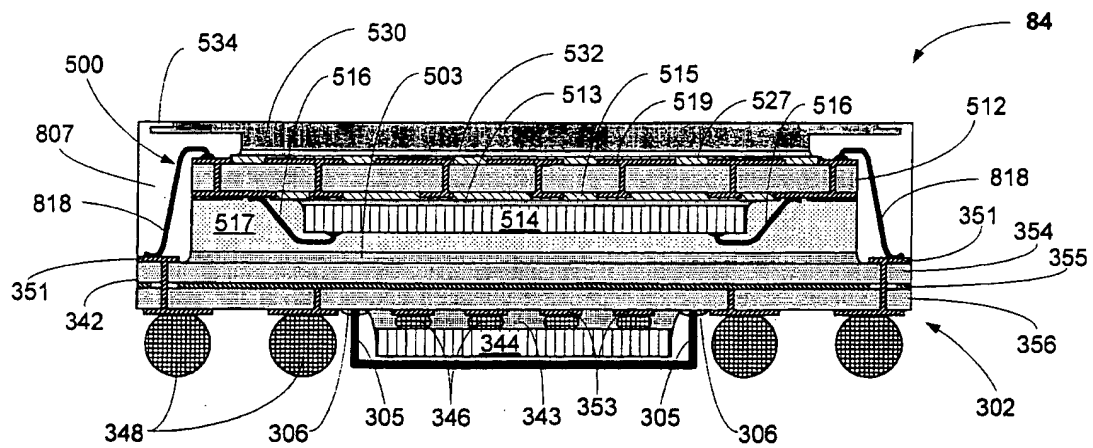


Fig. 8C